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**FEASIBILITY OF SHIPPING
FRESH APRICOTS AND PRUNES JUMBLE
PACKED IN FIBERBOARD BOXES**

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FEASIBILITY OF SHIPPING FRESH APRICOTS AND PRUNES JUMBLE PACKED IN FIBERBOARD BOXES

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Summary

Two shipping containers for fresh apricots and two for fresh prunes were tested to compare the cost of using them and to find out how well they protect the fruit from bruising. These were: For apricots—row-faced wood box containing 14 pounds of apricots and jumble-packed fiberboard box containing 12 pounds; for prunes— $\frac{1}{2}$ bushel, ring-faced wood-veneer basket and jumble-packed fiberboard box, each containing 30 pounds of prunes.

Costs and charges for packaging materials, direct labor for packing and loading in railcars, equipment, cold room, and transport were higher for the face packs. These costs were 1.5 cents more per pound of apricots for the wood box than for the fiberboard box and 1.8 cents

more per pound of prunes for the wood-veneer basket than for the fiberboard box.

The number of bruised apricots was nearly the same for the two boxes tested. Thirty-six percent of the apricots shipped in the wood box was bruised compared with 33 percent of those in the fiberboard box.

More of the prunes were bruised in the baskets than in the fiberboard boxes. Only 7 percent of the prunes shipped in the fiberboard boxes were bruised compared with 21 percent of those in the wood-veneer baskets.

General adoption of these jumble-packed fiberboard boxes would have resulted in estimated annual savings of \$530,000 for western-grown apricots and \$953,000 for prunes (1966).

Introduction

Rising costs of labor and materials have forced a reappraisal of shipping containers for fresh apricots and prunes. The row-faced wood box for apricots and the ring-faced wood-veneer basket for prunes have been the most commonly used containers for shipping these fruits to market for many years.

California, Washington, and Utah supply most of the fresh apricots to the U.S. market. Oregon, Idaho, and Washington supply most of this country's fresh prunes. Both early- and late-season varieties of Italian prunes and most varieties of apricots produced in the Northwest

are suitable for jumble packing. The Perfection variety of apricots is larger than other varieties of apricots, and this variety is now mostly face-packed in four-basket crates.

The purpose of this study was to find out (1) how much the cost of marketing these fruits could be reduced if they were packed and shipped in fiberboard boxes instead of in wood boxes or wood-veneer baskets, and (2) if the bruising of apricots and prunes would be greater or less by jumble packing them in fiberboard boxes.

Procedure

Packaging materials costs for the four packages were obtained from manufacturers and suppliers.

Direct labor costs for packing and loading were obtained by conducting time studies in five apricot packinghouses and seven prune packinghouses. The rate of output was timed, and the workers on the packing line were counted. Some off-line operations, such as loading, box nailing, and label pasting, required separate time studies. A \$1.65 per hour wage rate was used to calculate packing and loading labor costs.

Costs of packinghouse equipment were obtained from owners or managers of apricot and prune packinghouses.

Cold-room costs were obtained from the owner of a Northwest packinghouse-design firm. The cost per square foot of cold room was based on a 10-day storage period.

Transport charges were determined by calculating rail and refrigeration charges for shipping apricots and prunes in the four types of containers from Yakima Valley stations to the cities covered in the U.S. Department of

Agriculture market news reports of unloads of fruits and vegetables in the eastern, western, midwestern, and southern areas of the United States. The calculated average transport charges to each of these four areas were weighted by the relative quantities of apricots and prunes shipped to each area to arrive at the average transport charge.

Costs of receiving, precooling, supervision, sales, and overhead were not included in this study.

Six test shipments of apricots and four test shipments of prunes were made from the Northwest to various eastern markets. All test shipments were made in rail refrigerator cars. A randomized complete block experimental design was used, and each shipment contained both wood and fiberboard boxes of apricots or 1/2-bushel wood-veneer baskets and fiberboard boxes of prunes. Fruit from the same lot was used in each shipment, and the bruising of the fruit was determined by visual inspection upon the arrival in terminal markets. Bruising was recorded in three categories: slight, damage, and serious bruising.

Description of Shipping Containers and Packing Operations

The shipping containers tested for apricots were: (1) a six-piece nailed wood box with a capacity of 14 pounds of apricots in which the top layer of fruit was row-faced; and (2) a fiberboard box with a capacity of 12 pounds of apricots in which the fruit was jumble packed (fig. 1).

The shipping containers tested for prunes were: (1) a 1/2-bushel wood-veneer basket with a capacity of 30 pounds of prunes in

which the top layer was ring-faced; and (2) a fiberboard box with a capacity of 30 pounds of prunes in which the prunes were jumble packed (fig. 1).

The fiberboard boxes tested were two-piece full-telescope boxes. These boxes could be assembled and closed by stapling, stitching, or gluing.

The components of the containers were:

<i>Fiberboard boxes</i>	<i>Wood box for apricots</i>	<i>Wood-veneer basket for prunes</i>
1. Inside box (half-slotted carton)	1. Sides (2)	1. Basket
2. Printed outer cover (half-slotted carton)	2. Ends (2)	2. Lid
3. Staples or glue	3. Slatted top	3. Chipboard pad
	4. Slatted bottom	4. Chipboard liner
	5. Chipboard liner	5. Face fringe
	6. Chipboard pad	6. Paper label and glue
	7. Paper label and glue	7. Ribbon
	8. Nails	

A typical packing line has about 30 to 50 workers in the line; the number depends on the fruit and the container being packed. An example of the number of workers used on apricot and prune packing lines is shown in

table 1. Figure 2 shows typical equipment for jumble packing apricots and ring facing prunes. Many packinghouses use part or all of the same equipment to pack various kinds of fruits.

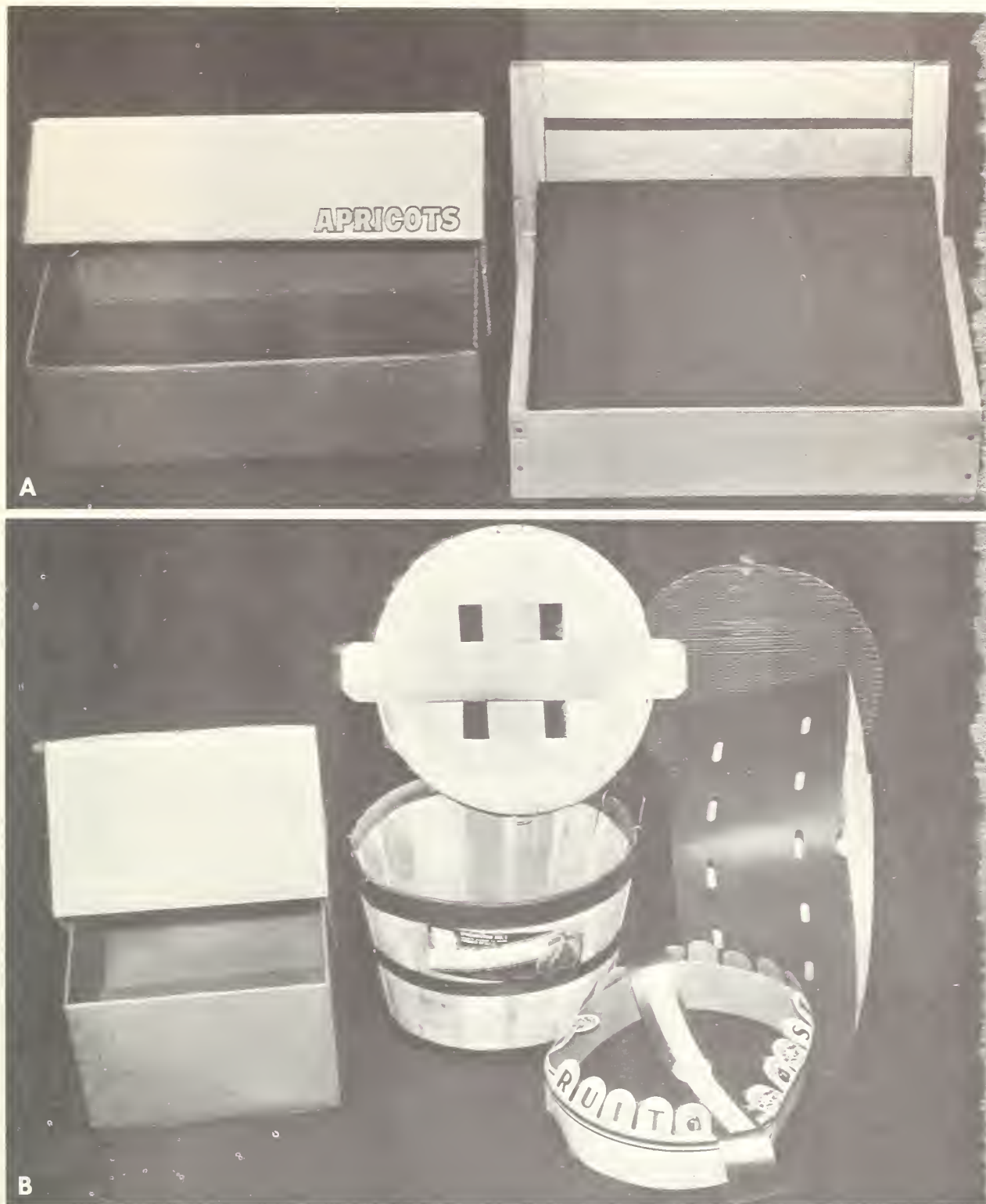


FIGURE 1.—A, Containers for apricots: Left, 12-pound fiberboard box; right, 14-pound wood box. B, Containers for prunes: Left, 30-pound fiberboard box; right, 30-pound wood-veneer basket, with the corrugated top pad, liner, and face fringe.

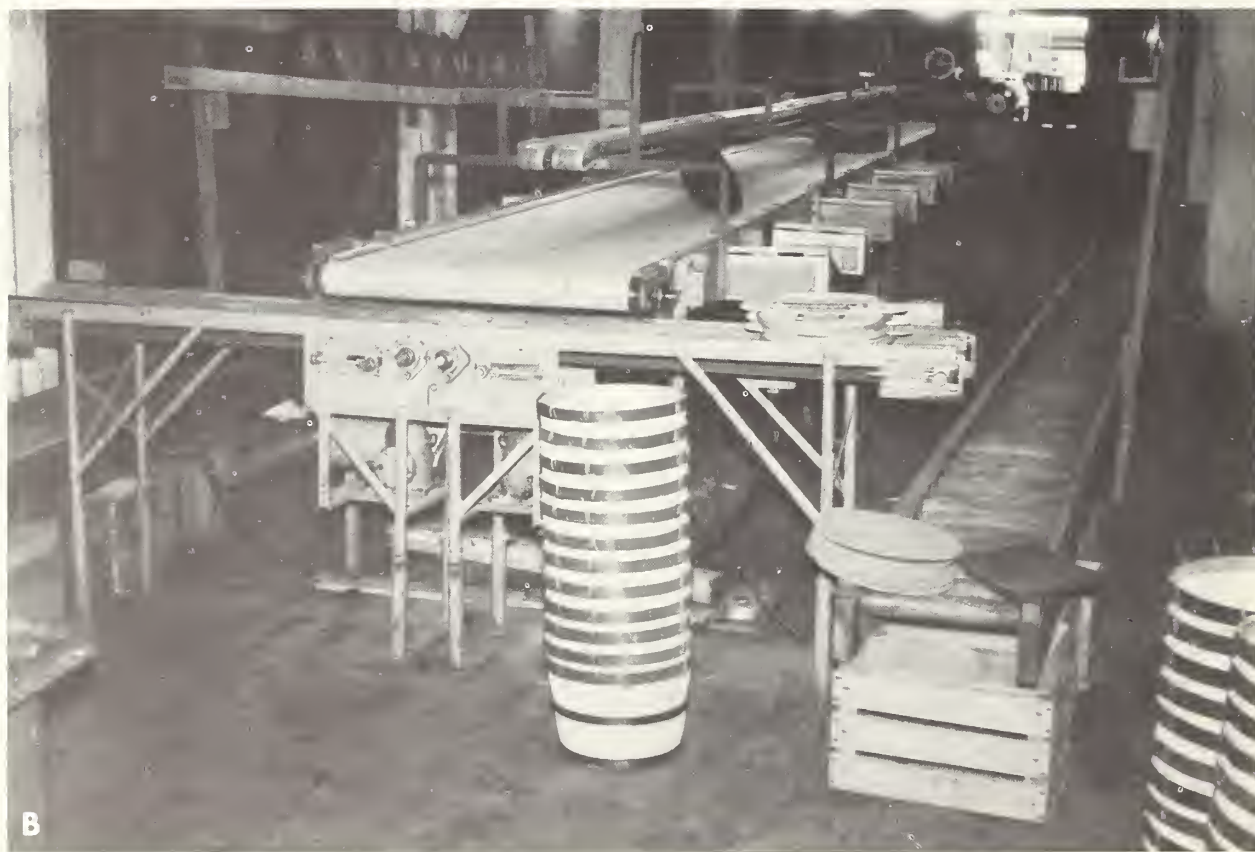
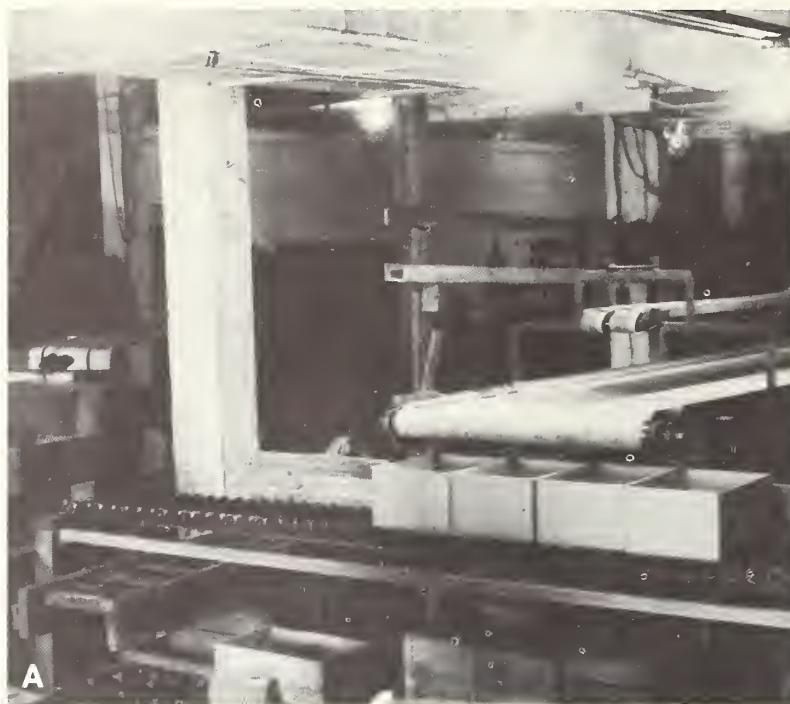


FIGURE 2.—*A*, Equipment for jumble packing apricots; *B*, equipment for ring facing prunes.

TABLE 1.—*Workers used on a typical packing line for packing fresh apricots and prunes in the Northwest, 1967*

Operation	14-pound wood box	12-pound fiberboard box	30-pound wood- veneer basket	30-pound fiberboard box
	Number	Number	Number	Number
Dump	3	3	3	3
Sort	6	12	14	14
Pack and close box	¹ 29	15	¹ 32	15
Total	38	30	49	32

¹ 14 workers were needed for facing.

Usually the packed fruit is placed on pallets and stored in a cold room (fig. 3), but sometimes the packed fruit is loaded into railcars for immediate shipment.

Output of packed boxes per hour was 430 for the 14-pound wood box, 750 for the 12-pound fiberboard box, 370 for the 30-pound wood-veneer basket, and 430 for the 30-pound fiberboard box. By jumble packing apricots or prunes into the fiberboard box, a given volume of fruit can be packed faster and with a smaller crew than by packing the fruit into the wood boxes and wood-veneer baskets where each container must be faced.



FIGURE 3.—A, A pallet load of 14-pound wood boxes; B, a pallet load of 12-pound fiberboard boxes; C, pallet loads of 1/2-bushel, 30-pound wood-veneer baskets and of 30-pound fiberboard boxes.

Costs and Charges

Materials and Direct Labor Costs

The costs of packaging materials and direct labor to pack and load were 2.6 cents per pound of apricots for the 14-pound wood box and 1.6 cents for the 12-pound fiberboard box (table 2).

The costs of packaging materials and direct labor to pack and load were 2.6 cents per pound of prunes for the 30-pound wood-veneer basket and 1.2 cents for the 30-pound fiberboard box (table 2).

TABLE 2.—*Costs of packaging materials and direct labor to pack and load apricots and prunes into railcars, by type of container, Northwest, 1967*¹

Item	Apricots		Prunes	
	14-pound wood box	12-pound fiberboard box	30-pound wood-veneer basket	30-pound fiberboard box
	Cents	Cents	Cents	Cents
Packaging materials.....	21.4	12.8	54.0	23.1
Direct labor:				
Dump and sort.....	3.6	3.1	7.2	6.6
Pack.....	11.2	3.4	14.4	5.7
Load in rail cars.....	.7	.5	1.2	.9
Total.....	36.9	19.8	76.8	36.3
Cost per pound of fruit..	2.6	1.6	2.6	1.2

¹ These are direct costs only and do not include costs such as supervision, overhead, fieldmen, insurance, sales, and office workers.

Equipment Costs

Cost for equipment to pack apricots was 0.355 cent per pound for the 14-pound wood box and 0.296 cent for the 12-pound fiberboard box (table 3).

Cost for equipment to pack prunes was 0.217 cent per pound for the 30-pound wood-veneer basket and 0.197 cent for the 30-pound fiberboard box (table 3).

TABLE 3.—*Costs for equipment per packing line to pack apricots and prunes in specified shipping containers, Northwest, 1968*¹

Item		Apricots		Prunes	
		14-pound wood box	12-pound fiberboard box	30-pound wood-veneer basket	30-pound fiberboard box
Replacement cost ²	dollars	12,000	10,000	11,000	10,000
Annual cost per packing line ³	dollars	1,776	1,480	1,628	1,480
Cost per pound ⁴	cents	0.355	0.296	0.217	0.197
Cost per box ⁵	cents	5.0	3.6	6.5	5.9

¹ Estimated season output is 500,000 pounds of apricots and 750,000 pounds of prunes.

² \$4,000 for a 40-foot belt packing line and \$6,000 for a 25-percent share of other equipment used (bin dumper, screen, conveyor, filler, stapler). The additional \$2,000 for the wood box is for two box-nailing machines and the additional \$1,000 for the wood-veneer basket is for extra equipment, such as rings and automatic turnover, for ring facing the prunes. Costs were obtained from packinghouse operators.

³ Method used by Reed, R. H., Mitchell, F. G., Gentry, J.P., and others, "Technical and Economic Evaluation of New and Conventional Methods of Packing Fresh Peaches and Nectarines," Univ. Calif., Agr. Expt. Sta., Agr. Ext. Serv. Giannini Found., Agr. Econ. and Market. Econ. Div., ERS, U.S. Dept. Agr., No. 64-1, March 1964. Costs were based on an annual fixed charge of 14.8 percent of replacement costs of equipment.

⁴ Obtained by dividing annual cost for a packing line by the pounds of fruit.

⁵ Obtained by dividing annual cost for a packing line by number of boxes of fruit packed per season.

Cold-Room Costs

Cost for cold-room space per pound of packed apricots was 0.082 cent for the 14-pound wood box and 0.077 cent for the 12-pound fiberboard box (table 4).

Cost for cold-room space per pound of packed prunes was 0.104 cent for the 30-pound wood-veneer basket and 0.064 cent for the 30-pound fiberboard box (table 4).

TABLE 4.—*Cost for cold-room space for storing packaged apricots and prunes, Northwest, 1967*¹

Item	Apricots		Prunes	
	14-pound wood box	12-pound fiberboard box	30-pound wood-veneer basket	30-pound fiberboard box
Weight of fruit (2 pallets high) pounds.....	2,240	2,376	1,980	2,880
Cold-room floor space per pallet ²				
square feet.....	17.33	17.33	19.34	17.33
Floor space per 100 pounds of fruit				
square feet.....	0.744	0.729	0.977	0.602
Cold-room cost: ³				
Per pound.....cents.....	0.082	0.077	0.104	0.064
Per box.....cents.....	1.2	0.9	3.1	1.9

¹ Estimates of costs—not prices charged for commercial cold-storage space.

² Allowing 2 inches overhang for palletized baskets and adding 30 percent aisle space for all pallets. Boxes were stacked on 48- by 40-inch pallets.

³ Cost is based on \$2.26 per square foot per year. This yearly cost is based on a 100- by 100-foot building costing \$85,000 and refrigeration equipment costing \$45,000. Yearly costs for this cold-room space are: \$6,400 for 25-year building and 15-year refrigeration depreciation; \$2,600 for taxes and insurance at 2 percent of \$130,000; \$3,900 for interest at 3 percent of \$130,000; \$4,800 for operational costs of water, electricity, and refrigeration; \$1,300 for maintenance of equipment at 1 percent of \$130,000; and \$3,600 for operating labor. An average 10-day storage period over an average 7-month use period is assumed. Data were obtained from Food Industries Research and Engineering, Yakima, Wash.

Transport Charges

The average railroad transport charge per pound of apricots was 2.9 cents for the 14-pound wood box and 2.5 cents for the 12-pound fiberboard box (table 5).

The average railroad transport charge per pound of prunes was 2.8 cents for the 30-pound wood-veneer basket and 2.4 cents for the 30-pound fiberboard box (table 5).

Combined Costs and Charges

The cost of packaging materials, labor to pack and load, equipment, cold room, and transport per pound of apricots was 6.0 cents for the 14-pound wood box and 4.5 cents for the 12-pound fiberboard box (table 6).

These costs were about 33 percent greater for the 14-pound row-faced wood box than for the 12-pound jumble-packed fiberboard box. The higher cost of labor for face packing the wood boxes than that for jumble packing the apricots in the fiberboard boxes was the principal factor accounting for the difference in costs of the two types of containers.

The cost of packaging materials, labor to pack and load, equipment, cold room, and transport per pound of prunes was 5.7 cents for the 30-pound wood-veneer basket and 3.9 cents for the 30-pound fiberboard box (table 6).

These costs were about 46 percent greater for the ring-faced 30-pound wood-veneer basket than for the 30-pound jumble-packed fiberboard box. Packaging materials and packing labor were the principal factors accounting for the higher cost of packing prunes in the wood-veneer baskets.

TABLE 5.—*Railroad transport charges for apricots and prunes packed in specified containers from Yakima Valley stations, Washington, to eastern, western, mid-western, and southern markets, 1967*

Item		Apricots		Prunes	
		14-pound wood box	12-pound fiberboard box	30-pound wood-veneer basket	30-pound fiberboard box
Gross weight ¹	pounds.....	31,680	34,240	31,065	38,160
Net weight.....	pounds.....	26,880	32,100	28,500	36,000
Transport charges: ²					
Eastern.....	cents.....	3.2	2.8	3.0	2.7
Western.....	cents.....	2.5	2.2	2.2	³ 1.3
Midwestern.....	cents.....	2.9	2.5	2.8	2.5
Southern.....	cents.....	3.2	2.8	3.0	2.6
Weighted average.....	cents.....	2.9	2.5	2.8	2.4

¹ Calculated at 16.5 pounds for the 14-pound wood box, 12.8 pounds for the 12-pound fiberboard box, 32.7 pounds for the 30-pound wood-veneer basket, and 31.8 pounds for the 30-pound fiberboard box. Boxes per car were: 1,920 14-pound wood boxes; 2,675 12-pound fiberboard boxes; 950 wood-veneer baskets; and 1,200 30-pound fiberboard boxes.

² Freight rates per hundredweight and charges for standard refrigeration were calculated for each type of container to the following cities: (1) Eastern—Albany, Baltimore, Boston, Buffalo, New York, Philadelphia, Pittsburgh, Providence, and Washington, D.C.; (2) western—Denver, Los Angeles, and San Francisco; (3) midwestern—Chicago, Cincinnati, Cleveland, Detroit, Indianapolis, Kansas City, Louisville, Milwaukee, Minneapolis, St. Louis, and Wichita; and (4) southern—Atlanta, Birmingham, Columbia, Dallas, Fort Worth, Houston, Memphis, Miami, Nashville, New Orleans, and San Antonio. Weighted average rates and charges for each of the 4 areas were based on the quantity of fresh apricots and prunes shipped to the above cities during the last 3 years as reported by the Market News Branch, Fruit and Vegetable Division, Consumer and Marketing Service, U.S. Dept. of Agriculture, 1967. These were: (1) Eastern—\$868.74 for the 14-pound wood box, \$903.40 for the 12-pound fiberboard box, \$857.76 for the 30-pound wood-veneer basket, and \$959.88 for the 30-pound fiberboard box; (2) western—\$665.56 for the 14-pound wood box, \$711.39 for the 12-pound fiberboard box, \$629.41 for the 30-pound wood-veneer basket, and \$473.18 for the 30-pound fiberboard box; (3) midwestern—\$777.48 for the 14-pound wood box, \$810.44 for the 12-pound fiberboard box, \$801.95 for the 30-pound wood-veneer basket, and \$903.91 for the 30-pound fiberboard box; and (4) southern—\$854.12 for the 14-pound wood box, \$885.61 for the 12-pound fiberboard box, \$845.30 for the 30-pound wood-veneer basket, and \$948.20 for the 30-pound fiberboard box. The weighted average transport charge for the U.S. was based on the quantity of fresh apricots and prunes shipped into each area.

³ The use of 30-pound fiberboard boxes reduced freight charges particularly to San Francisco and Los Angeles because railcars could be loaded to "fill all space." This made it possible to obtain special freight rates. There is not enough space even in large railcars to load enough 30-pound wood-veneer baskets to qualify for the special freight rate.

TABLE 6.—*Costs of packaging materials and labor, equipment, cold room, and transport for apricots and prunes, by type of container, Northwest, 1967*

Item	Apricots		Prunes	
	14-pound wood box	12-pound fiberboard box	30-pound wood-veneer basket	30-pound fiberboard box
	Cents	Cents	Cents	Cents
Materials and labor.....	36.9	19.8	76.8	36.3
Equipment.....	5.0	3.6	6.5	5.9
Cold room.....	1.2	0.9	3.1	1.9
Transport.....	40.6	30.0	84.0	72.0
Total per box of fruit.....	83.7	54.3	170.4	116.1
Cost per pound of fruit.....	6.0	4.5	5.7	3.9

Bruising

Bruising was nearly the same for apricots face packed in the wood box and jumble packed in the fiberboard box (table 7). About 36 percent of the apricots packed in the wood box were bruised and about 33 percent of those packed in the fiberboard box. The differences in the amount of bruising, by degree of bruise, were not statistically significant.

Bruising was less for the prunes marketed in the fiberboard boxes than for those in the wood-veneer baskets (table 7). Of the prunes packed in the wood-veneer basket, 21 percent were bruised. Slightly less than 7 percent of those packed in the fiberboard box were bruised. The difference in total bruising was statistically significant. The wood-veneer baskets contained more prunes that were slightly bruised than the fiberboard boxes—12.9 percent compared with 4.4 percent. The difference was statistically significant. The differences in damage and seriously bruised prunes in the wood-veneer baskets and fiberboard boxes were not statistically significant.

TABLE 7.—Percentages of apricots and prunes bruised and degree of bruising, by types of containers, in test rail shipments from the Northwest to eastern terminal markets, 1966

Bruising ¹	Apricots ²		Prunes ³	
	14-pound wood box	12-pound fiberboard box	30-pound wood-veneer basket	30-pound fiberboard box
	Percent	Percent	Percent	Percent
Slight.....	30.4	29.1	12.9*	4.4*
Damage.....	4.1	3.2	4.9	1.8
Serious.....	1.1	.3	3.2	.6
Total.....	35.6	32.6	21.0*	6.8*

¹ Degrees of bruising are: Slight, bruising injury between $\frac{1}{4}$ and $\frac{1}{2}$ inch in diameter and less than $\frac{1}{8}$ inch in depth; damage, bruising injury between $\frac{1}{2}$ and $\frac{3}{4}$ inch in diameter and less than $\frac{1}{8}$ inch in depth; serious, bruising injury over $\frac{3}{4}$ inch in diameter or more than $\frac{1}{8}$ inch in depth.

² Percentages are averages of 6 shipments containing both types of containers; about 50 percent of the apricots in each box were inspected.

³ Percentages are averages of 4 shipments containing both types of containers; about 30 percent of the prunes in each box were inspected.

* Differences in bruising between the 2 types of containers were significant at the 5-percent level.

Discussion

In 1966, sales of fresh apricots in California, Washington, and Utah totaled 17,650 tons.¹ Calculated savings per pound of apricots were 1.5 cents for the jumble-packed fiberboard box compared with the face-packed wood box (table 6). Assuming that the savings resulting from jumble packing would be about the same in California as in the Northwest, the cost of packing and transport for western-grown apricots in jumble-packed 12-pound fiberboard boxes would have been \$530,000 less than

marketing them in 14-pound face-packed wood boxes.

In 1966, sales of fresh prunes in Idaho, Washington, and Oregon totaled 26,460 tons.² Calculated savings per pound of prunes were 1.8 cents for the jumble-packed 30-pound fiberboard box compared with the ring-faced $\frac{1}{2}$ -bushel wood-veneer basket. The cost of packing and transport for this tonnage of prunes in jumble-packed 30-pound fiberboard boxes would have been \$953,000 less than for marketing them in wood-veneer baskets.

¹ Agricultural Statistics, 1967, p. 257. U.S. Dept. Agr.

² Agricultural Statistics, 1967, p. 295. U.S. Dept. Agr.

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